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この実験で用いた試料は亜硝酸ナトリウムと二水素リン酸カリで，まず始めに，これら２つの試料の固体および液体状態のラマン散乱を測定した。そして次に，亜硝酸ナトリウムの結晶相と溶液相の界面そして結晶相と融液相の界面，さらに，二水素リン酸カリの結晶相と溶液相の界面からのラマン散乱の測定をした。

それらの結果より，すべての界面でそのラマン散乱シフトには変化がないことがわかった。すなわち，これは固液界面では新しい構造が出現していないことを意味している。また，亜硝酸ナトリウムの結晶相と融液相の界面のみ，そのラマン散乱光強度に変化があった。これは固液界面で密度または振動モードの揺らぎに起因するものと考えられる。

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1. Memory Effect in Rotational Brownian Motion

Chikako Uchiyama

Abstract

Dynamical properties of dielectrics are fully characterized by absorption and dispersion and thus many theoretical methods have been

proposed: Debye[1] obtained an expression for the dielectric function of the form $(1+i\omega\tau)^{-1}$ where ω is the angular frequency and τ is the relaxation time. Although the Debye theory is applicable to various materials, the theory cannot explain several important aspects of the polar molecules; for instance, the behavior in the short time region $t \ll \tau$ of relaxing dipole moment, because the inertial effect, the memory effect, and the interactions of molecules are thoroughly neglected.

Several authors took into account the inertial effect to explain the short time behavior. McConnel[2], for instance, obtained the dielectric function with the use of the Langevin-type equation which, however, does not contain any memory effect.

On the other hand, Van Vleck-Weisskopf[3] and Fröhlich[4] considered harmonically oscillating charges and obtained the dielectric function, but the memory effect was neglected.

In this thesis, a review of physical aspect of dielectrics and a summary of the damping theory are given in the first half and subsequently formulations are given by taking into account the memory effect and the inertial effect which may affect the dynamical properties of the dipole moment.

In our treatment the dielectric is assumed to be a dilute solution of disc polar molecules. In a basic Langevin-type equation, a random force, which originates from the molecules of the non-polar solvent, is assumed to be a Gaussian or a two-state-jump Markoff process.

In the case of the Gaussian fluctuating force, the Fokker-Planck type equation is exactly constructed by the TCL formula of the damping theory[11]; in the case of the two-state-jump fluctuating force, an approximate equation is obtained with the use of the TC formula.

On the basis of the above equations, the relaxation function, the dielectric function, and the distribution function are derived, and the fluctuation of the dipole moment is also determined. In the white noise limit, McConnel's result is derived in the case of the Gaussian fluctuating force and Van Vleck-Weisskopf, Fröhlichs' result is obtained in the case of the two-state-jump fluctuating force. The Debye's result is found in the narrowing limit irrespective of the stochastic processes. Detailed numerical calculations are given and several new aspects are found. Especially for the dielectric function, deviation at high frequencies from the Debye's result is found. This may corresponds to an experiment for polar liquid[7], though our model is so simple.

2. A Theory of Unified Stochastic Process

— with an application to light scattering —

Kishiko Maruyama

Abstract

In this thesis, two new types of solvable stochastic model are proposed and applied to light scattering phenomena. The theoretical framework for each model is made based on a time-convolution-type equation in the damping theory.

Each model is used to develop a theory of line shape, in which the influence of an environment for a relevant system is idealized so as to be represented with a stochastic process.